# Cozy Mk IV RUDDER RETURN SPRING ASSEMBLY
## WITH REMOVABLE ATTACHMENT POINTS

### OVERVIEW

This write-up describes the construction of the rudder return spring assembly with removable eye bolts instead of the floxed-in piano wire hooks. While this change increases the robustness of the spring attachment by using aircraft-grade hardware instead of pieces of bent piano wire, it was not done to address any known issues with the plans' design. The main purpose was to make the spring attachment points more serviceable by making them easier to install and remove, and to make it easier to detach the spring from the bottom of the aluminum tube.

The additional materials needed for each wing were:

- 2 eye bolts (AN42B-5A)
- 2 anchor nuts (K1000-3)
- some small pieces of 1/4 inch plywood
- a Sharpie marker

### STEP 1. ALUMINUM TUBE AND ATTACHMENT POINT

Figure 1 shows the general design of the spring assembly. Because the spring attachment points on the eye bolts are farther from their base than the wire hooks, the depth of the tube was increased from 4 inches to 4.85 inches. This maintained the 1 inch spring elongation at neutral rudder and preserved the same rudder return forces.

Figures 2 and 3 show the components for the eye bolt anchor at the bottom of the aluminum tube. Two small discs were made from 1/4-inch-thick plywood. One matched the outside diameter of the tube, and the other was made to fit snug inside the tube. The larger disc was center drilled for the eye bolt diameter and additional material was removed so the K1000-3 anchor nut fit into it snug and flush with the surface. The smaller disc was then center drilled for the eye bolt and epoxied on top of the larger one to 'sandwich' the anchor nut. The eye bolt was screwed in far enough to keep the discs concentric and care was taken to not get epoxy on the threads.

After cure, the eye bolt was screwed in fully and a plastic cap, large enough to fit over the protruding threaded portion of the eye bolt, was cut from the end of a Sharpie marker. This cap was epoxied to the back of the disc and protected the threads from flox when the aluminum tube was bonded into the winglet.

The eye bolt was removed and the exposed plywood surface around the hole was coated with epoxy so it would be sealed and protected from moisture. After cure, the disc assembly was epoxied into the bottom of the aluminum tube. Figure 5 shows the inside bottom of the tube after it was installed into the winglet.

## STEP 2. RUDDER ATTACHMENT POINT

Figure 6 shows the components for the spring retention hardware on the rudder. As with the tube in the winglet, the rudder side consisted of an anchor nut, an eye bolt and some small pieces of ¼-inch plywood. The anchor nut was sandwiched between pieces of plywood in a similar manner as the tube side, but the shape was narrower and elongated so it could be located closer to the rudder skin. This allowed the eye bolt to be installed in such a position that the return spring would not rub on the edge of the aluminum tube at any point of rudder deflection.

The bottom of this anchor did not need to be protected with a plastic cap because epoxy was not applied to that area when bonding it to the rudder foam. Before doing layup #6 in the rudder, a slot was cut out of the foam so the anchor could fit flush with the foam surface. Location was critical for proper spring alignment. Flox made with 5-minute epoxy was initially used to bond the plywood into position (Figure 7). The remaining voids around the anchor were later filled with flox when preparing the surface for layup #6.

The yellow material inside the hole in Figure 7 is a foam ear plug used to protect the threads from epoxy. The ear plug was rolled until very thin, and then inserted into the hole. (The same as the procedure for inserting it into the ear canal for hearing protection). It was given a few minutes to fully expand and then the top was sliced off flush using a fresh utility knife blade. The layup was done directly over this foam plug. After the layup cured, a glazing of epoxy was applied around the hole location to make the base of the anchor bolt sit more flush and better seal the hole from moisture. The glass was then drilled to open up the hole, being careful not to drill too far and damage the threads. The ear plug was picked/dug out manually using a small drill bit. Unlike materials such as wax that are sometimes used to protect threads from epoxy, the earplug foam can be completely removed without leaving any residue. Figure 8 shows the eye bolt installed.

## STEP 3. SPRING INSTALLATION AND REMOVAL

Installation of the spring was relatively easy and started with the rudder removed from the winglet, one eye bolt installed in the rudder and the other eye bolt attached to the spring. This is where the piano wire came in handy. An improvised tool was made by bending a small 90 degree angle at one end of the wire so it hooked into the eye bolt hole that had the spring attached, and guided it down the tube and into position. A larger bend at the other end of the wire was used to apply torque to screw the eye bolt in. After it was tightened, the rudder was attached to the winglet and the spring was hooked onto the eye bolt on the rudder. To remove the spring, the rudder end of the spring was unhooked, the rudder was removed, and then the wire tool was used to unscrew the eye bolt and spring from the tube. To make it even easier, the piano wire was made into a custom tool by replacing the larger bend with a wood dowel for a handle, and adding another small hook at the base of the handle to hold the spring. With a little practice, removal and installation of the spring could be done in a few seconds, as shown here:
**https://youtu.be/SrPyh_s79lA**

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**Figure 1**

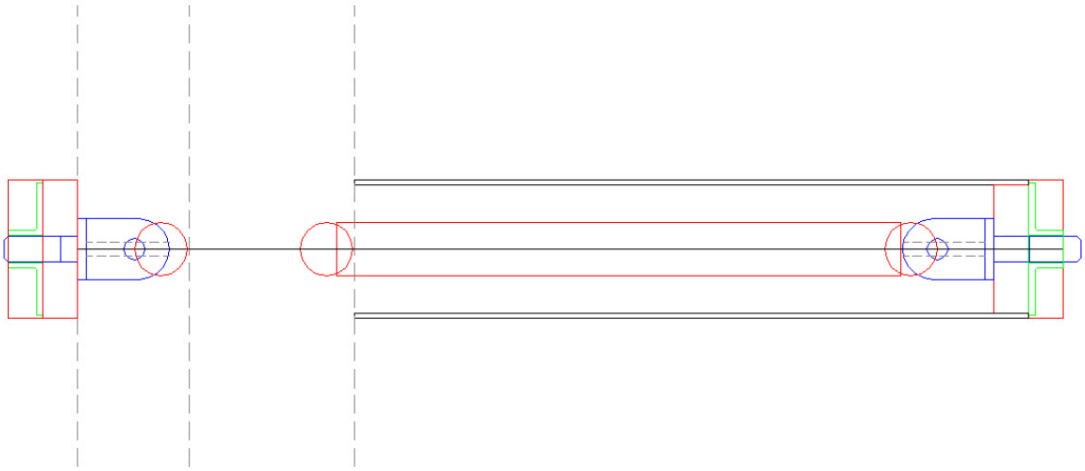

**Figure 2**

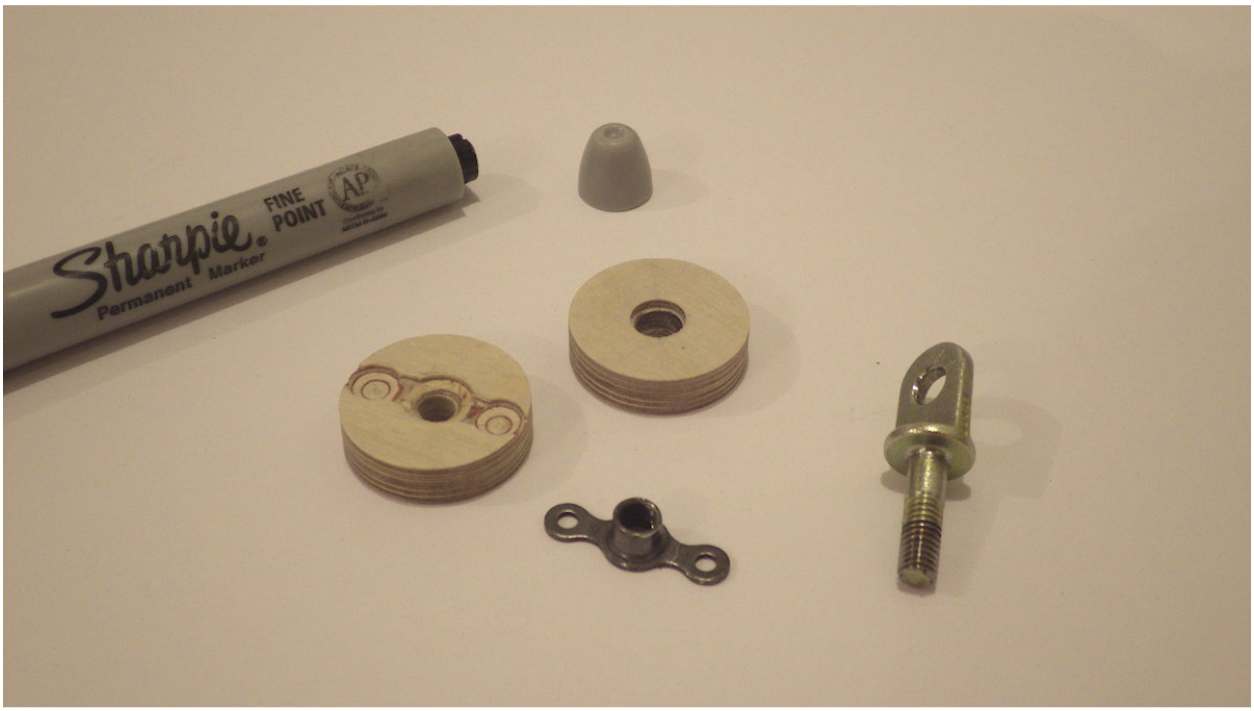

**Figure 3**

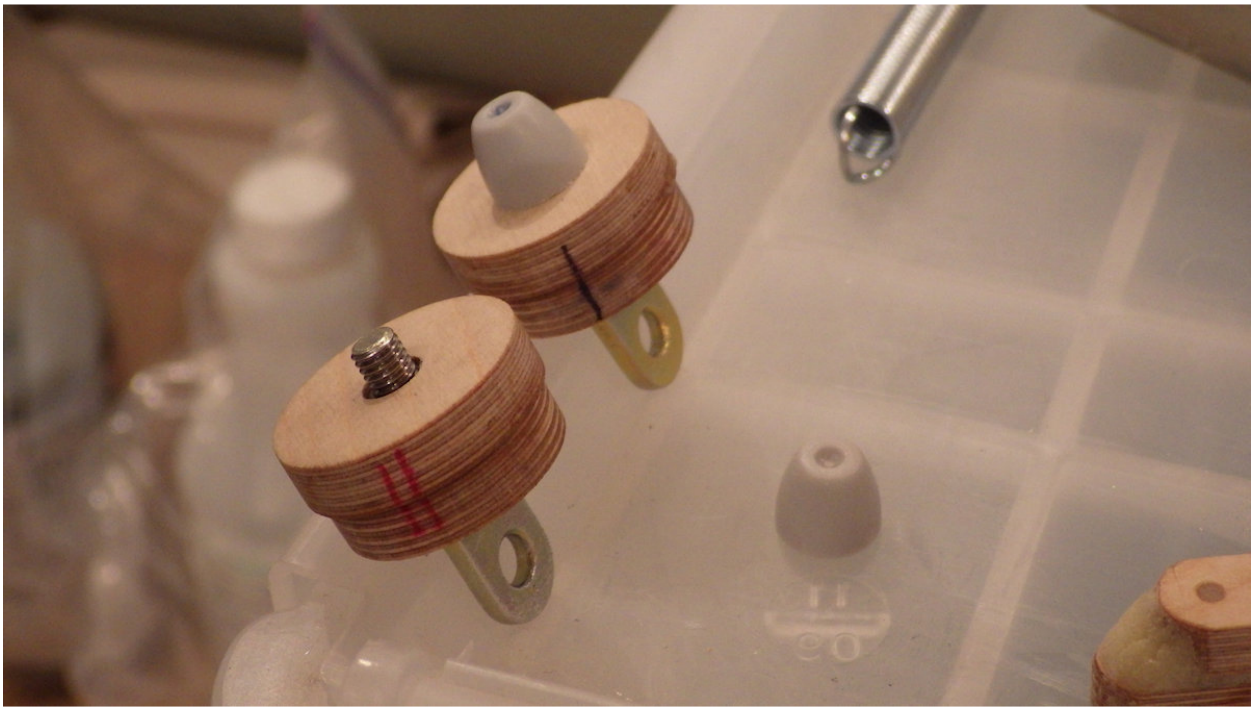

**Figure 4**

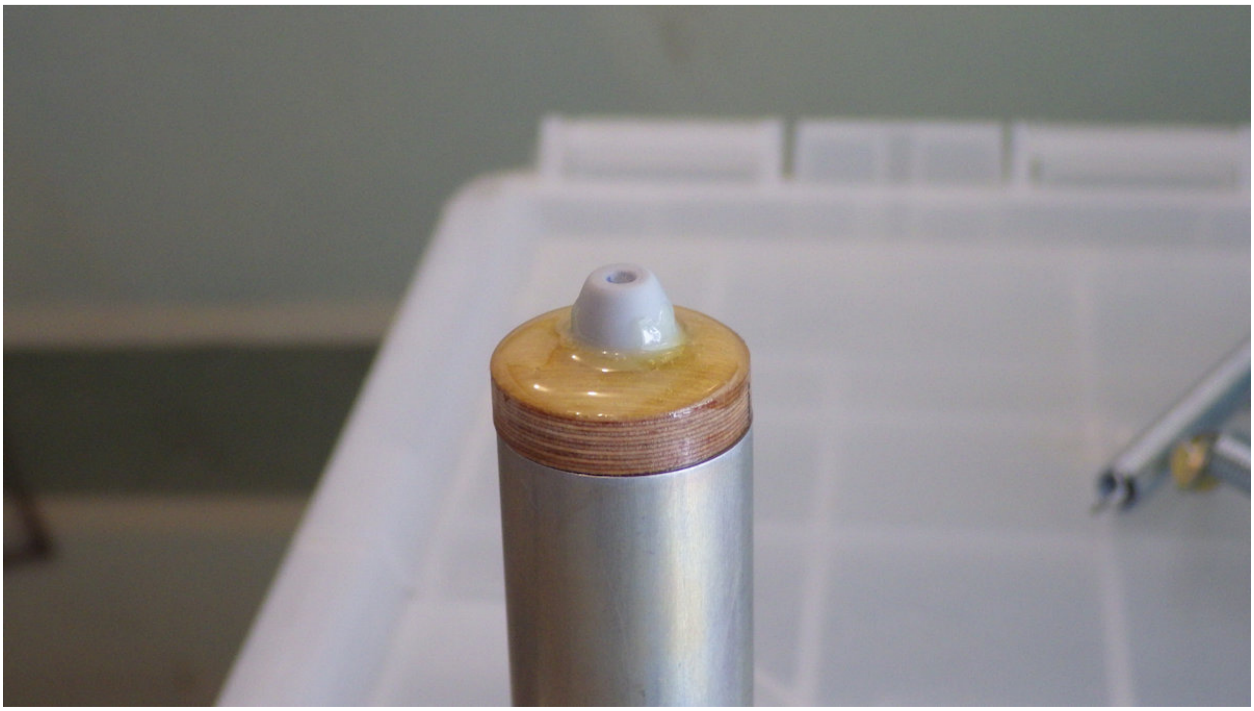

**Figure 5**

**Figure 6**

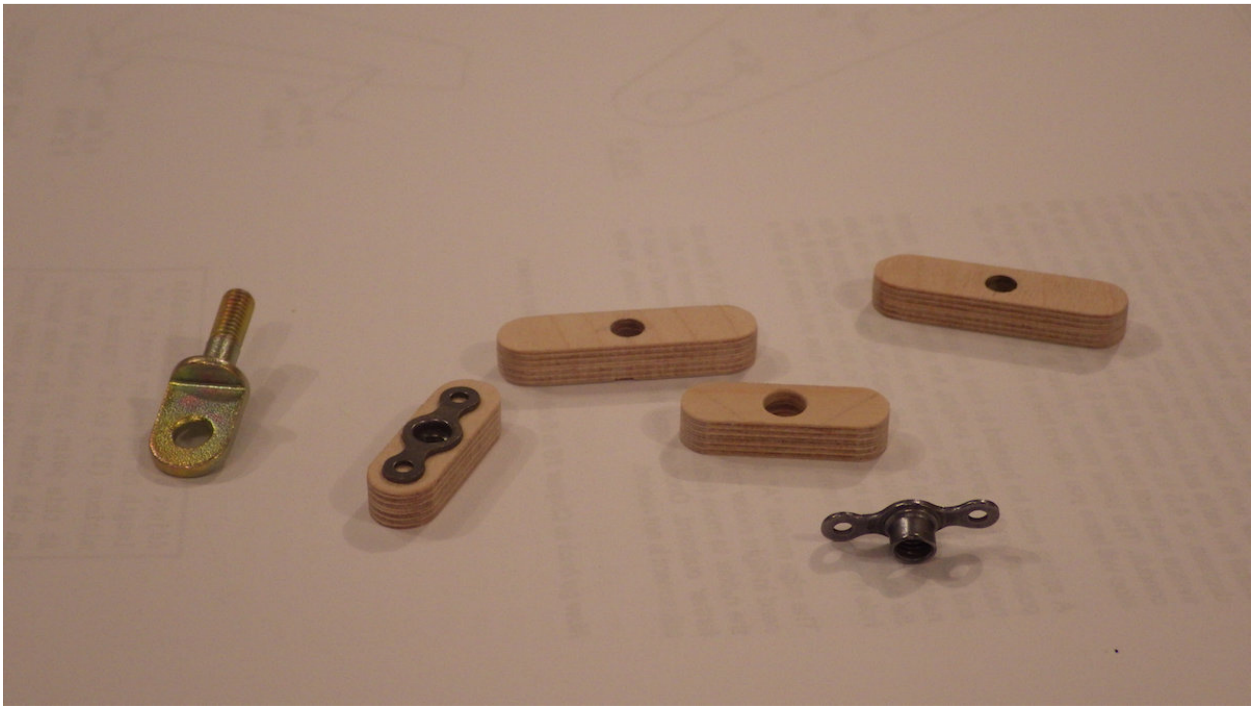

**Figure 7**

**Figure 8**

**Figure 9**